SECTION 3.6

GEOLOGY AND SOILS

3.6 Geology and Soils

This evaluation of geology and soils impacts incorporates the results of the Geotechnical Investigation prepared by Leighton and Associates for the Merriam Mountains Property on November 9, 2006, and for the Smith Property on December 2, 2005 (see Appendix J to the Merriam Mountains Specific Plan Draft EIR, dated August 2007). In addition, an Addendum Geotechnical Evaluation of Rockfall Potential was prepared by Leighton and Associates (see Appendix J to this EIR).

3.6.1 Discussion of Existing Conditions Relating to Geology and Soils

Subsurface Soil and Rock Conditions

The earth materials encountered throughout the site consist of undocumented fill, topsoil/culluvium, alluvium, Quaternary slopewash, possible Quaternary landslide deposits, Cretaceous granitic rock, and Jurassic-Cretaceous rock. These units are described in the following sections in order of increasing age.

Undocumented Fill Soils

Undocumented fill soils located on the site were generally associated with the grading of the on-site dirt roads and water tower pads. Undocumented fills on the project site are localized and are believed to be of limited extent.

Topsoil/Colluvium

The topsoil/colluvium material surrounds the middle to lower portions of the hillsides across the majority of the site. The potentially compressible topsoil is estimated to be approximately 0 to 2 ft thick. Localized areas of thicker accumulations of topsoil may be encountered. On hillsides of higher elevation, topsoil is minimal.

Alluvium

Quaternary-aged alluvium is present in the bottom of the canyons and drainage on the site. Similar to colluvial deposits, these soils are generally thin (less than 3 ft). Alluvial soils likely underlie all of the on-site canyons and are considered potentially compressible.

Quaternary Slopewash

Quaternary slopewash includes residual materials shed from slopes and deposited on the lower portions of the slopes and within localized drainages. Resistant clays of relatively unweathered

granite are locally suspended within the deposits, which are on the order of 5 to 20 ft thick. These deposits are generally medium-dense to dense but are still locally porous and compressible.

Possible Quaternary Landslide Deposits

Review of geologic literature indicates the presence of possible ancient landslide debris on the eastern edge of the site. The landslide has only been mapped based on its surficial expression and has not been confirmed by a subsurface investigation.

Cretaceous Granitic Rock

Granitic rock outcrops were observed across the vast majority of the site and granitic rock underlies the site in areas that are not exposed at the surface. The material generally consists of medium- to coarse-grained quartz-rich granite rock. Large granitic boulders characterize the outcrops in the upper regions of the site; while in the mid to lower regions of the site, weathered granitic material was observed in road cuts below the topsoil/colluvium.

Jurassic-Cretaceous Metavolcanic Rock

Metavolcanic rocks are mapped within a narrow band along the western margin of the site, including the quarry area located to the northwest. These rocks generally form more subdued erodible topography than the adjacent Cretaceous granitic rocks mapped to the east and west.

Surface and Groundwater Conditions

Surface water and shallow groundwater conditions were not encountered at the project site. However, surface flow is anticipated in the on-site drainages after periods of heavy rainfall. In addition, an area of possible seepage has been reported in the northern section of the site near the abandoned dirt airfield.

Near-surface groundwater seepage should be anticipated at the topsoil–bedrock contact after periods of heavy rainfall. It is anticipated that groundwater levels will fluctuate during periods of high precipitation and/or irrigation and may become perched on the underlying bedrock or concentrated in fractures within the bedrock. Localized seeps may occur after periods of rainfall or irrigation in cut areas along fractures and/or joint systems.

Faulting and Seismicity

Based on the commonly accepted definition provided by the California Mining and Geology Board, an active fault is a fault that has had surface displacement within Holocene time

(approximately the last 11,000 years). The state geologist has defined a potentially active fault as any fault considered to have been active during Quaternary time (the last 1,600,000 years). These definitions are used in delineating earthquake fault zones as mandated by the Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code, Section 2621 et seq.). The intent of this act is to ensure that any urban development planned on or near traces of active faults is planned in accordance with seismic safety considerations.

The project site is located within the seismically active Southern California region. However, the site is not located within an earthquake fault zone and there are no active, potentially active, or inactive faults that transect the project site. The nearest known active regional fault is the Elsinore-Julian Fault. The closest projected trace for this fault zone is located approximately 13 mi. east of the site. The Elsinore-Julian Fault is predicted to generate a maximum magnitude of 7.1, with an estimated peak horizontal ground acceleration of 0.19 *g* at the project site.

Subsidence/Ground Rupture

Soil rupture refers to the rolling motion of the ground surface by the passage of seismic surface waves. Effects of this nature are likely to be most severe where the thickness of soft sediments varies appreciably under structures. Breaking of the ground because of faulting is not likely to occur on site due to the absence of known faults on the project site.

Liquefaction

Liquefaction and dynamic settlement can be caused by strong vibratory motion due to earthquakes. Research and historical data indicate that loose, saturated granular soils are susceptible to liquefaction and dynamic settlement. Liquefaction is typified by a loss of shear strength in the affected soil layer, thereby causing the soils to act as a viscous liquid. This effect may be manifested by excessive settlements and sand boils at the ground surface. The rock materials underlying the site are not considered liquefiable due to their dense physical characteristics and unsaturated condition. Saturated alluvium soils at the site may have a potential for liquefaction; however, soils sampled did not reveal significant thickness of saturated alluvium.

Landslides and Rockfalls

The project site is not located within a state- or county-defined landslide hazard zone. However, the natural slopes are subject to surficial instability and granitic boulder outcrops are located within the project site, which is rugged and heavily vegetated. Potential rockfall hazard areas are depicted on the Geotechnical Map (Plate 1 of Appendix J of this EIR). During a significant seismic event, the potential exists for isolated rockfalls to occur on site.

Paleontological Resources

The site is underlain by three geologic formations: Quaternary slopewash, Cretaceous granitic rock, and Jurassic-Cretaceous metavolcanic rock (see Appendix J to the Merriam Mountains Specific Plan Draft EIR, dated August 2007). Quaternary slopewash is generally classified as having a low sensitivity rating for potential fossils (Demére and Walsh 1993). The Cretaceous granitic rock formation typically consists of coarse-grained, quartz-rich granite rock. This formation has zero sensitivity to bear potentially significant paleontological resources. The Jurassic-Cretaceous metavolcanic rock formation has a low sensitivity rating for potential fossils (Demére and Walsh 1993). For paleontological resources, Quaternary slopewash, Cretaceous granitic rock, and Jurassic-Cretaceous metavolcanic rock all have a low to zero sensitivity to contain fossiliferous rock.

3.6.2 Guidelines for the Determination of Significance

The project would have a significant geology and soils impact if:

1) The project does not conform to the goals and requirements of applicable federal, state, or local regulations for soil erosion, loss of topsoil, or siltation, including, but not limited to, the Clean Water Act, Porter-Cologne Water Quality Act, County of San Diego Revised Grading Ordinance, or County of San Diego Watershed Protection, Stormwater Management, and Discharge Control Ordinance.

2) The project site is located within a Highly Expansive Soils Zone and the project does not conform to the Uniform Building Code (UBC). Soils are placed within the high shrink-swell category if the amount of clay and predominant clay mineral is greater than 30% mixed or montmorillonitic clays (United Stated Department of Agriculture, Part III, San Diego Soil Survey, 1973).

3) *Fault Rupture.* The project is located within an Alquist-Priolo or County Fault Rupture Zone.Within these zones, the following uses are proposed, which are prohibited:

   - Storage of hazardous materials within 50 ft of an identified fault trace
   - Any subdivision of land that is subject to the Subdivision Map Act (Division 2 (commencing with Section 66410) of Title 7 of the Government Code), which contemplates the eventual construction of structures for human occupancy
   - Uses containing structures with a capacity of 300 persons or more. Any use having the capacity to house, serve, entertain, or otherwise accommodate 300 or more persons at any one time.

- Uses with the potential to severely damage the environment or cause major loss of life. Any use having the potential to severely damage the environment or cause major loss of life if destroyed, which includes dams, reservoirs, petroleum storage facilities, and electrical power plants powered by nuclear reactors.
- Specific civic uses: police and fire stations, schools, hospitals, rest homes, nursing homes, and emergency communications facilities.

In addition, projects do not conform to the following construction limitations:

Construction Limitations. No building or structure to be used for human occupancy shall be constructed over or within 50 ft of the trace of an active fault. For purposes of these regulations, a building or structure to be used for human occupancy is one that is regularly, habitually, or primarily occupied by humans. Exceptions to these construction limitations include the following:

- Buildings and structures not intended or used for human occupancy
- Alterations or repairs to an existing structure, provided that the aggregate value of the work performed does not exceed 50% of the value of the existing structure and does not adversely affect the structural integrity of the existing structure
- A single-family wood frame dwelling not exceeding two stories in height that is built or located as part of a development of less than four such dwellings
- A mobile home whose body width exceeds 8 ft
- Swimming pools, decorative walls, fences, and minor work of a similar nature.

4) *Seismic Shaking Zones*. The project is located within a county Near-Source Seismic Shaking Zone, and the project does not conform to the UBC.

5) *Landslide Hazard Zones*. The project site is either located within a state- or county-defined Landslide Hazard Zone or lies within the proximity of such a hazard zone that the site would be affected in the event of failure of the off-site slope(s). The factor of safety (FS) for the slope's stability is the following:

$$FS = \frac{\text{Available Soil Shear Strength}}{\text{Equilibrium Shear Stress}}$$

a. Static Slope Stability Analysis: $FS \leq 1.5$

b. Seismic Slope Stability Analysis: $FS \leq 1.1$ (when using a minimum horizontal ground acceleration factor of 0.15)

There are numerous methods of static and seismic slope stability analysis.

The slope is considered to be at the point of failure when the factor of safety equals 1 or the available soil shear strength exactly balances the shear stress induced by gravity.

Guideline Sources

The identified significance thresholds are based on criteria provided in Appendix G of the State CEQA Guidelines, as well as the County of San Diego and UBC standards described above. These thresholds are intended to ensure conformance with existing regulatory and industry standards, as well as to protect public safety and private property from geologic and related hazards.

3.6.3 Analysis of Project Effects and Determination of Significance

Guideline 1: Conformance with federal, state, and local regulations in regard to erosion control

The potential for erosion would increase during construction activities as a result of vehicles and heavy equipment accelerating the erosion process. Any exposed soil surface may be susceptible to wind or water erosion. Wind erosion could occur on bare soils or where vehicles and equipment cause dust. A Stormwater Pollution Prevention Program (SWPPP) is required as part of the General Permit for Stormwater Discharges associated with construction activity (General Permit No. CAS00002), administered by the State Water Resources Control Board (SWRCB). A SWPPP will be included for the proposed project prior to construction that identifies specific best management practices (BMPs) to minimize erosion and control sedimentation. These environmental design considerations are listed in Chapter 1, Project Description, of the EIR. Impacts would, therefore, be considered short term in nature and would be less than significant due to the BMPs incorporated into the project design for construction.

During the operation phase of the project, disturbed soils would be stabilized with vegetation and landscaping, which would reduce the erosion potential to less than significant. For additional discussions on soil erosion and water quality, refer to Section 3.4, Hydrology and Water Quality, of the EIR.

Guideline 2: Expansive Soils

The majority of the on-site soils are expected to have a very low to low expansion potential per California UBC criteria. However, the following soil formations include expansive properties. The topsoil/colluvium consists of damp to moist, loose to medium dense soils, which are typically massive, porous, and organic. All existing undocumented fills located on the site are considered potentially compressible and unsuitable in their present state for structural support. Alluvium is also considered potentially compressible and will need to be removed to competent

bedrock material in areas of proposed development. Quaternary slopewash deposits are medium dense to dense but are still locally porous and potentially compressible. This unit is not suitable for the support of additional fill or structural loads. Therefore, the undocumented fill, topsoil/colluvium, alluvium, and Quaternary slopewash formational materials are porous and/or potentially compressible in their present state. Impacts would be significant (Impact GE-1).

Guideline 3: Fault Rupture

No active or potentially active faults are known to exist on or in the immediate vicinity of the project site. In addition, the project site is not located in a hazard zone identified by the Alquist-Priolo Earthquake Fault Zone Map. The nearest known active regional faults are within the Elsinore-Julian Fault Zone. The closest projected trace for this fault zone is located approximately 13 mi. east of the site. Ground rupture due to faulting is not likely to occur on site due to the absence of known faults on the site. Cracking due to shaking from distant seismic events may occur but is not considered a significant hazard. The effects of seismic ground shaking and ground acceleration will be reduced as the project adheres to the most recent edition of the California UBC and design parameters of the Structural Engineers Association of California as well as the County of San Diego engineering standards. Therefore, impacts from faulting are considered less than significant.

Guideline 4: Seismic Shaking Zones

Like most of Southern California, the project site is subject to ground shaking and seismic forces from regional active faults; however, no special setbacks or design parameters are necessary other than those required by the UBC. Additionally, due to the high-density characteristics of the on-site bedrock materials and lack of a groundwater table, the potential for liquefaction in bedrock areas is considered low. However, saturated alluvial soils at the site may have the potential for liquefaction, which would result in a significant impact (Impact GE-2).

Rockfalls

To evaluate the potential for rockfall hazards on future building pads and/or roadways during seismic events, the site grading plan was plotted on an aerial photo base. The resulting limits of potential rockfall hazard zones are shown on Plate 1 in Appendix J to this EIR. In addition, two certified geologists with Leighton and Associates completed a site visit to observe hillsides located above proposed improvements. Leighton concluded that all of the areas observed to have potential rockfall issues due to exposed boulders are located either within the proposed limits of grading, where the boulders would be removed during grading operations or upslope of development pads within the adjacent fuel modification zones. In general, site development has been planned to avoid development below natural steep slope areas with granitic boulder

outcrops where there is a potential for isolated rockfalls to occur during a significant seismic event, as most of the boulders that could become rockfall hazards will be removed as part of grading operations. As shown on Plate 1 of Appendix J to this EIR, rockfall hazards outside of the proposed limits of grading may potentially affect 28 lots within the development and portions of Meadow Park Lane and Merriam Mountains Parkway. In the event that structures are placed downslope of the potential rockfall hazard zones shown on Plate 1~~from granitic boulder outcrops~~, impacts from rockfalls would be considered potentially significant (Impact GE-3).

Guideline 5: Landslide Hazard Zone

The project site is not located within a state- or county-defined Landslide Hazard Zone; however, a possible ancient landslide has been mapped along the eastern edge of the project site, which is located out of the influence of the proposed development. Natural slopes on site are subject to surficial instability, as indicated by the presence of slopewash deposits, source area scars, and perched granitic boulder outcrops. Such areas are of particular significance when located above and immediately adjacent to proposed development; therefore, impacts would be significant (Impact GE-4).

3.6.4 Cumulative Impact Analysis

Geotechnical conditions are localized and generally unique to each site. Approved projects and those under review are subject to soils and stability analyses and cannot be constructed unless each project is determined to be geotechnically feasible. The project is not located adjacent to other cumulatively considerable projects, related to geotechnical conditions; therefore, cumulative impacts related to localized site stability would not occur. With regard to seismicity, the project and any future development would expose additional property and people to earthquake hazards. However, this impact can be mitigated by compliance with UBC seismic requirements on a project-by-project basis. Development throughout northeastern San Diego County would not impact the plate tectonic conditions of the area. Therefore, no significant cumulative geologic impacts would result.

~~Cumulative impacts are also discussed in the Cumulative Technical Report, provided as Appendix R of this EIR.~~

3.6.5 Growth-Inducing Impact

The proposed project is located within the coastal subprovince of the Peninsular Ranges, in an area suitable for commercial and residential development. As discussed in the Growth Inducement Technical Report (Appendix S to the Merriam Mountains Specific Plan Draft EIR, dated August 2007), the proposed project would result in the addition of 720 dwelling units (du):

100 du from the Bonsall Sponsor Group area, 200 du in the Hidden Meadows Community Group area, and 420 du in the Twin Oaks Sponsor Group area. As discussed above in this section and in the Geotechnical Evaluation (see Appendix J to the Merriam Mountains Specific Plan Draft EIR, dated August 2007), the soils and geologic conditions on site do not exhibit substantial constraints that would require extraordinary measures to allow development. A project-related geotechnical impact would be mitigated to less than significant. Therefore, potential impacts from the proposed project to the proposed growth generated by the project would be less than significant. In addition, each potentially growth-inducing project would be subject to a soils and subsiding analysis and cannot be constructed unless each project is determined to be geotechnically feasible. Therefore, the geologic conditions for the project site and the surrounding area are suitable for development and no significant geology/soils impacts with respect to growth inducement are identified.

Summary of Impacts

The following geology and soils impacts have been identified:

Impact GE–1 Undocumented fill, topsoil/colluvium, alluvium, and Quaternary slopewash are porous and/or potentially compressible in their present state.

Impact GE–2 Saturated alluvium soils within the project site have the potential to result in liquefaction.

Impact GE–3 Granitic boulder outcrops ~~located~~in areas upslope from approximately 28 development lots could result in isolated rockfalls during a significant seismic event.

Impact GE–4 Natural slopes on site are subject to surficial instability, as indicated by the presence of slopewash deposits, source area scars, and perched granitic boulder outcrops.

3.6.6 Mitigation Measures

M–GE–1a Geotechnical observation and/or laboratory testing during grading shall be performed to identify areas of highly expansive soils and determine the actual expansion potential of finish-grade soils. Compressible soils will require removal and recompaction in areas of proposed development or future fill.

M–GE–1b The proposed project's grading plans shall demonstrate compliance with remediation recommendations in the November 9, 2006, Geotechnical Investigation prepared by Leighton and Associates for the Merriam Mountains

Property and the Smith Property (Appendix J to the Merriam Mountains Specific Plan Draft EIR, dated August 2007), including but not limited to:

- In order to minimize the effects of potential differential settlement, increased compaction and settlement monitoring is recommended for fills greater than 50 feet in depth.
- All fill slopes should have a minimum width of at least one-half the slope height.

M–GE–2 Alluvium soils shall be removed and replaced with compacted fill in areas of proposed grading/development as recommended in the Geotechnical Investigation (Appendix J to the Merriam Mountains Specific Plan Draft EIR, dated August 2007).

M–GE–3 ~~Mapping and evaluation of potential oversteepened areas of granitic boulders with potential for mobilizations shall be performed as plans become finalized and during site grading.~~ All boulders located within the proposed development footprint will be removed during grading. Potentially hazardous boulders identified on Plate 1 of Appendix J to this EIR and located within the proposed fuel modification zones would either be ~~To reduce impacts from rock falls, grading activities in these areas shall include one of the following actions: removal of dangerous boulders, support for boulders to remove the threat, or construction of a deflection/catchment berm or fence.~~removed or broken in place as described in Table 1 of Appendix J of this EIR. The removal of the boulders shall be completed prior to approval of final inspection of site grading for each phase of the affected areas of the proposed project. Evidence shall be provided to the satisfaction of the Director of DPLU demonstrating that hazardous boulders have been removed and/or broken in place as recommended in Appendix J to this EIR. (*Alternate methods for addressing the rockfall hazard may be proposed in the future. Any such methods would be subject to review and approval by the County of San Diego and may involve additional environmental review.)*

M–GE–4a Surficial ~~in~~stability shall be ensured through buffering areas without structural development, construction of debris walls, catchment basins, or slope ~~reconstruction and~~ buttressing. The need for such mitigation shall be based on review of final grading plans and field observations during grading.

M–GE–4b Mapping of all cut slopes shall be performed during grading. If adverse geologic conditions (e.g., highly fractured and jointed rock, clay-lined fractures, seepage

zones) are ~~present~~encountered during installation of cut slopes, stabilization measures such as ~~the placement of~~ stability fill or rock-bolting shall be required.

3.6.7 Conclusion

Undocumented fill, topsoil, colluvium, alluvium, slopewash, and weathered formational materials are porous and/or potentially compressible in their present state and are considered unstable for development (Impact GE-1). Mitigation measures M-GE-1a and M-GE-1b would reduce expansive soil impacts to less than significant. Saturated alluvium soils could also result in liquefaction, which would be unsuitable for development (Impact GE-2). Implementation of Mitigation Measure M-GE-2 would reduce liquefaction impacts to less than significant. Other impacts identified from potential seismic activities would result from rockfalls if structures are placed downslope from granitic boulder outcrops (Impact GE-3). Implementation of Mitigation Measure M-GE-3 would reduce impacts from rockfalls to less than significant because through removal of boulders and/or breaking the boulders in place would ensure the rocks that could become dislodged are removed prior to completion of grading. As seen in Table 1 of Appendix J to this EIR, ground disturbance resulting from the proposed mitigation (i.e., removal of boulders, breaking in place) would occur within the development footprint and/or fuel modification zones, resulting in no additional ground disturbance from that already evaluated in the EIR. Due to the instability of certain on-site soils, the possibility exists for ~~landslides~~ some surficial instability to occur (Impact GE-4); however, the incorporation of Mitigation Measures M-GE-4a and M-GE-4b would reduce potential impacts ~~from landslides~~ to less than significant. Although surficial instability has been identified as a significant impact, measures routinely utilized during construction grading are available to reduce impacts to less than significant. Any required remedial grading or other slope stabilization work would substantially remain within the anticipated development footprint (i.e., limits of grading).

Therefore, it should be noted that all potential geologic impacts would be reduced to less than significant through the implementation of the mitigation measures listed above and compliance with the recommendations of the Geotechnical Investigation prepared by Leighton and Associates (Appendix J to the Merriam Mountains Specific Plan Draft EIR, dated August 2007).

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